

Rapid Assessment Reference Condition Model

The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004-2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.

Potential Natural Vegetation Group (PNVG):

R#MTHE

Mountain Hemlock

General Information

Contributors (additional contributors may be listed under "Model Evolution and Comments")

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Vegetation Type

Forested

Dominant Species*

VACCI TSME
PICO
ABAM
CHNO

General Model Sources

- Literature
 Local Data
 Expert Estimate

LANDFIRE Mapping Zones

1 8
2 9
7

Rapid Assessment Model Zones

- California Pacific Northwest
 Great Basin South Central
 Great Lakes Southeast
 Northeast S. Appalachians
 Northern Plains Southwest
 N-Cent.Rockies

Geographic Range

This type occupies some of the highest-elevation forested zones in Cascade and Olympic Mountains. Above the elevation of closed forest, the type can exist as tree clumps in a matrix of parkland.

Biophysical Site Description

The lower elevation limit of the type ranges from about 5000' in southern Oregon to about 4000' in northern Washington. Sites are cold and characterized by deep and persistent snowpacks and short growing seasons.

Vegetation Description

Stands are generally dominated by mountain hemlock, though a wide variety of other tree species are present throughout the geographic range of the type. In some areas, lodgepole pine dominates post-disturbance stands. Mature stands may be nearly all mountain hemlock, or may have varying amounts of Pacific silver fir, Alaska yellow cedar, and subalpine fir. Common understory species include Alaska huckleberry, big huckleberry, grouse whortleberry, and beargrass.

Disturbance Description

Wildfire is the major disturbance event of this type, although the frequency of fire tends to be low. Fire is generally stand-replacing, since the major tree species are highly susceptible to fire mortality. Estimates of the return of wildfire range from 500 to over 1500 years. The root rot *Phellinus weirii*, bark beetles, and other insects can be locally important disturbance agents.

Adjacency or Identification Concerns

The type is immediately upslope from the wet Pacific silver fir types in the north, and the Red Fir type in the south Oregon Cascades. Upslope from this type are subalpine and alpine park lands, and in some cases whitebark pine forest or parkland. Along moisture gradients (i.e., west to east across either the Olympic or Cascade Mountains), this type can grade into the subalpine fir type.

*Dominant and Indicator Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

Scale Description

Sources of Scale Data Literature Local Data Expert Estimate

In areas of continuous forest, fire sizes can range from 10s of acres to at least 10,000 acres. At upper elevation parkland areas, discontinuous fuels can limit fire spread and extent. Root-rot patches can be up to about 100 acres.

Issues/Problems

According to This and Sturrock, *Phellinus weirii* is distributed from northern California to southern British Columbia, and east to western Montana. So it seems likely that it could affect mountain hemlock anywhere it grows in Oregon or Washington. This part of our model would not be applicable to other parts of the range of mountain hemlock.

Model Evolution and Comments

We assumed that class A can go to class B or class C, with roughly twice the probability of moving to class B.

To start with, we assumed that stand-replacing fire affects all classes with a frequency of 750 years. The insect/disease disturbance of class B is mountain pine beetle, which can thin or destroy the stand. Based on personal communication from Ellen Goheen and Beth Willhite, the effect of *Phellinus weirii* is to maintain some portion of the landscape in a semi-permanent, semi-open condition with scattered lodgepole pine, western white pine, subalpine fir, and other species. We modeled this as a loop maintaining portions of the landscape in class C.

For classes D and E, we used mixed fire to represent small (e.g., single tree lightning fires) fires that create gaps. (This infrequent fire was modeled in VDDT as 0.0001 probability (~10,000 yrs). The insect/disease for classes D and E represent *Phellinus weirii*.

Succession Classes
Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).

Class A 10%

Early1 PostRep

Description

The first few years following stand-replacing wildfire are characterized by bare ground, herbs, shrubs, and varying densities of tree seedlings (presumably dependent on seed sources). Dominant species include various huckleberries, beargrass, lodgepole pine, and mountain hemlock. [Succession to class B after 50 years. Replacement fire (MFRI about 750 years) sets it back to time zero. Depending on seed source or lack of regeneration success, about one third of the stands develop directly into class C (Alt. Succession, probability 0.33).]

Indicator Species* and Canopy Position

VACCI
 XETE
 PICO
 TSME

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	no data	no data
Tree Size Class	no data	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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Class B 10%

Mid1 Closed

Description

This class represents rapid regeneration by lodgepole pine. Typical understory species for the type are usually present (i.e., huckleberry species, fool's huckleberry, and various herbs). Trees are in sapling and small pole size. [Succession to class D (open canopy/late) after 150 years. Replacement fire (MFRI about 750 years) resets. Insect and disease could reset to class A at 0.05 probability. Additionally, Insect and disease can maintain these young open stands, or open them up to class C (probability 0.007 for each pathway.)]

Indicator Species* and Canopy Position

PICO
VACCI

MEFE

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	<i>Min</i>	<i>Max</i>
<i>Cover</i>	50 %	80 %
<i>Height</i>	no data	no data
<i>Tree Size Class</i>	no data	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 15%

Mid1 Open

Description

This class represents delayed tree regeneration and long-term domination by shrubs and herbs. Shrubs include big huckleberry and grouse whortleberry. Herbs include beargrass and sedges. Trees are represented by seedlings and saplings of mountain hemlock and other species. This class can persist for decades, eventually transitioning to class D after 150 years in this class. [Replacement fire MFRI 750-800 years. Insect and disease can maintain it in class C but at a small extent (probability 0.0001).]

Indicator Species* and Canopy Position

VACCI
XETE
TSME
CAREX

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	<i>Min</i>	<i>Max</i>
<i>Cover</i>	20 %	50 %
<i>Height</i>	no data	no data
<i>Tree Size Class</i>	no data	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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Class D 10%

Late1 Closed

Description

This class represents the period when lodgepole is senescing and mountain hemlock (and Pacific silver fir) are recruiting into the stand. Typical understory species are present. [After 100 years the stands fill-in to class E.

Replacement fire MFRI 750-800 years. In small patches (probability 0.0001 each), mixed fire or insect/disease could kill the older trees and move this stand back to class C.]

Indicator Species* and Canopy Position

PICO
TSME
ABAM
VACCI

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	80 %
Height	no data	no data
Tree Size Class	no data	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class E 55%

Late2 Closed

Description

This class represents late-successional stands with large individuals (>20 inches in diameter) of mountain hemlock and other species, advanced regeneration of mountain hemlock and other shade tolerant species, and typical understory species. [Maintains in class E.

Replacement fire MFRI 750-800 years. In small patches (probability 0.0001), mixed fire or insect/disease can kill older trees and reset to class C.]

Indicator Species* and Canopy Position

TSME
ABAM
CHNO
VACCI

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	50 %	90 %
Height	no data	no data
Tree Size Class	no data	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

Non-Fire Disturbances Modeled

- Insects/Disease
- Wind/Weather/Stress
- Native Grazing
- Competition
- Other:
- Other:

Fire Regime Group: 5

- I: 0-35 year frequency, low and mixed severity
- II: 0-35 year frequency, replacement severity
- III: 35-200 year frequency, low and mixed severity
- IV: 35-200 year frequency, replacement severity
- V: 200+ year frequency, replacement severity

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Historical Fire Size (acres)

Avg:
Min:
Max:

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class. All values are estimates and not precise.

Sources of Fire Regime Data

- Literature
- Local Data
- Expert Estimate

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	750	500	1500	0.00133	92
Mixed	10000			0.0001	7
Surface					
All Fires	697			0.00144	

References

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press, Washington, D.C. 493 p.

Dickman, A.W. 1984. Fire and *Phellinus weirii* in a mountain hemlock (*Tsuga mertensiana*) forest: postfire succession and the persistence, distribution, and spread of a root-rotting fungus. Ph.D. dissertation, Univ. of Oregon, Eugene, OR.

Dickman, A., and S. Cook. 1989. Fire and fungus in a mountain hemlock stand. *Can. J. Bot.* 67: 2005-2016.

Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, 452 p.

Hansen, E.M. and E.M. Goheen. 2000. *Phellinus weirii* and other native root pathogens as determinants of forest structure and process in western North America. *Annu. Rev. Phytopathol.* 38:515-39.

Hemstrom, M.A., S.E. Logan, and W. Pavlat. 1987. Plant association and management guide, Willamette National Forest. Publication R6-Ecol-257b-1986. USDA Forest Service, Pacific Northwest Region, Portland, OR. 312 p.

Henderson, J.A., D.H. Peter, R.D. Leshner, and D.C. Shaw. 1989. Forested Plant Associations of the Olympic National Forest. USDA Forest Service, Pacific Northwest Region. R6 ECOL Technical Paper 001-88. 502 p.

Lillybridge, T.R.; Kovalchik, B.L.; Williams, C.K.; Smith, B.G. 1995. Field guide for forested plant associations of the Wenatchee National Forest. PNW-GTR-359. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 337p.

McCauley, K.J. and S.A. Cook. 1980. *Phellinus weirii* infestation of two mountain hemlock forests in the Oregon Cascades. *Forest Science* 26(1): 23-29.

Means, J.E. 1990. *Tsuga mertensiana* (Bong.) Carr., mountain hemlock. Pp. 623-634 in R.M. Burns and B.H. Honkala, tech. coords. *Silvics of North America: Vol. 1, conifers.* Agric. Handb. 654. USDA Forest Service, Washington, DC

Thies, W.G., and R.N. Sturrock. 1995. Laminated root rot in western North America. Gen. Tech. Rep. PNW-GTR-349. USDA Pacific Northwest Research Station, Portland, OR. 32 p.

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